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English translation of PCT/CH00/00388

PLASTIC SCREW CAP

The present invention relates to a screw cap made of a plastic material for screwing onto a thread on a neck of a bottle, according to the preamble of claim 1.

During storage and transportation of carbonated liquids and in particular of fruit juices, which are susceptible to an after-fermentation in the bottle subsequent to the bottling or after the first opening, there is a latent risk that pressure within the bottle will increase to such an extent that the bottle, be it made of glass or plastic, will burst and cause serious injuries or material damage. For this reason, tests have been conducted for providing the plastic screw caps used for closing bottles with a blow-off means, which, upon excess of a predetermined pressure within the bottle, enables the excess pressure to be blown-off.

In DE-C1 42 41 341 is disclosed the provision of a closing membrane supported in a bottle cap above the edge of the bottle opening via a circumferential annular rib. This support rib is coupled with the cap bottom or the closing membrane in such a manner that, with a bulging of the cap bottom or of a sealing disk or the closing membrane resting against the cap bottom, caused by an overpressure within the closed bottle, the rib allows same to be lifted from the edge of the bottle and hence an automatic ventilation of the inner bottle space. Furthermore, a plastic screw cap for closing a bottle is known from DE-A1 198 47 001 which dispenses with a closing membrane. Inside the screw cap, a sealing lip having a cone-shaped sealing surface is arranged, which rests against an outer sealing edge of the circular top face of the orifice of the bottle when the screw cap is screwed on. Recesses are provided in the cone-shaped sealing surface which extend from a zone closely outside the sealing edge

with the screw cap being screwed on, towards the edge of the sealing lip, and which are in communication with the surroundings. With a dome-shaped bulging of the bottom of the screw cap upon an increase of the inner pressure, the sealing ring, with its sealing surface, slides on the sealing edge. As soon as the pressure within the bottle, and therefore the bulging of the bottom, is sufficiently large, the recesses become adjacent the zone of the sealing edge and thus create a passage for the gases from the interior of the bottle to the surroundings, so that an overpressure be released.

These two known screw caps enable pressure blow-off when there is an excessive inner pressure within the bottle. However, the spread of uncertainty of the moment of the blow-off and hence also of the pressure is very large. As a result there is only a conditional and hence an insufficient safety margin for the user.

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It is an object of the present invention to provide a screw cap which enables a pressure blow-off upon an overpressure within a narrowly delimited pressure range.

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This object is solved by means of a screw cap having the features of claim 1. Further advantageous configurations of the invention are defined in the depending claims

By the provision of the sealing lip partially resting on the orifice of the bottle and partially enclosing the outer periphery, and the elastically deformable closure membrane disposed in between, it is possible to predetermine the blow-off moment and the blow-off pressure, respectively, in a sufficiently exact manner. The relative movement between a root of the sealing lip at the cap bottom and the bottle neck during a bulging of the cap, owing to an increased pressure within the bottle, can also be predetermined.

In addition, a segmentation of the sealing lip has an advantageous effect. By means of the segmentation, depending on the requirements made on the sealing lip, the sealing lip can be divided into 'n' circle segments having minimum tangential distances, or can be provided having distances exhibiting the same as or a greater length than the lengths of the segments of the sealing lip.

By using the elastic recovery force of the cap bottom, which comprises the energy storing component, a tight reclosure of the bottle is also achieved after the desired pressure drop.

The invention will now be described in more detail by way of example with reference to the accompanying drawings.

Figure 1 is a cross-section of a screw cap with a closure membrane inserted prior to it being screwed onto a bottle neck, and with a first-opening security band;

Figure 2 shows a detail of the screw cap shown in Figure 1 to an enlarged scale;

Figure 3 is a cross-section of part of the screw cap after it has been screwed onto a bottle neck under normal pressure;

Figure 4 is a cross-section of part of the screw cap and the bottle neck at increased internal pressure but before blow-off;

Figure 5 is a cross-section of part of the screw cap and the bottle neck at an overpressure permitting blow-off of the excess pressure; and

Figure 6 is a view from below of a bottom of the cap showing, in the left half of the drawing, a segmented sealing lip with indentations and, in the right half of the drawing, a segmented sealing lip with large spacings.

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The screw cap 1 shown in the Figures 1 through 6 comprises a cap bottom 3 and attached thereto a substantially cylindrical cap envelope 5, at the inner side of which a screw thread 7 is formed. On the outer side of cap envelope 5, ribs 9 or such like can be provided, which facilitate the removal of the cap from the neck 11 of a bottle 13 (Figures 3 through 5). At the lower edge 14 of the screw cap 1, a first-opening security band 16 can be provided in a known manner by injection molding.

In the zone above the thread 7, the cap envelope 5 defines an inner cylindrical portion 15, at the top of which is formed an arced or frusto-conical second portion 17 connecting it to the cap bottom 3. In the region of the arced or frusto-conical second portion 17, the thickness of the wall of screw cap 1 is decreased so as to be substantially smaller than that in the region of the cap bottom 3. A sealing lip 19 adjoins the second portion 17 with an outer peripheral surface 21, which in an unpressurized condition, has a substantially cylindrical shape parallel to that of the cylindrical portion 15 opposite it. The sealing lip 19 extends from a peak S_2 of a groove 22 formed between the cylindrical portion 15 and the outer surface 21 to a height h_1 within the interior of screw cap 1 to a tip 24 of the sealing lip 19. From the tip, an inner side 23 of the sealing lip 19 initially extends substantially parallel to the outer surface 21, and is then thickened at a step P, which acts as a pressure edge to impart a greater rigidity to the sealing lip 19 close to its root 29. Step P is situated at a height h_2

(Figure 1). An inner radial side 25 of the sealing lip 19 runs from step P at a slightly inwardly inclined angle up to a height h_3 and there ends at a peak S_1 (cf. Figure 1). The sealing lip 19 may take the form of a circumferential ring (Figures 1 and 2), or can be divided into a plurality of ring segments (Figure 6).

If the sealing lip 19 is divided into segments 19', various configurations are possible: in one these the circumferential sealing lip 19 is only subdivided into several segments 19' by way of indentations 19'' as shown in the left half of Figure 6, but in another configuration, spaces are left between the segments 19', the length A of which corresponds to the length B of the segments 19' or are larger, as shown in the right half of Figure 6. In preferred embodiments, the segments 19' and the spacings each define 60° angles or 45° angles.

The reduction of the thickness of the cap bottom 3 in the area of at least peak S_1, forms an elastic region, which permits a relative movement, to be described later, between the sealing lip 19 and the cap bottom 3 when the latter bulges. A second downwardly extending wall 27 of a groove 28 defined below peak S_1, ends approximately at the height h_2 and forms the outer side of a rib-shaped spacer 31 that rests above a top face 33 of the bottle neck 11 when the screw cap 1 is screwed on to the bottle 13. Concentric to the spacer 31 is a further resilient spacer 35, that is also formed in a rib-shaped manner. The cap bottom 3 may also define a circumferential groove 36 to the inner side of the radially inner spacer 35, which provides a local reduction in the thickness of the cap bottom 3.

A disk-shaped sealing or closure membrane or liner 37 made of soft plastic is held loosely above the thread 7 close

to the bottom 3 and spaced from the peaks of the sealing lip 19 and the spacers 31 and 35. Preferably, the thickness d_1 of the membrane 37 between its periphery and the region where it may contact the spacer 35, is larger than its thickness d_2 in its central zone. Alternatively, it is possible to configure the membrane 37 as an annulus that which extends radially substantially from the thread 7 to a position radially within the interior spacer 35. The periphery 38 of the membrane 37 lies beyond the peripheral surface 21 of the sealing lip 19, so that the tip 24 of the latter for a short term can rest against the membrane 37, before the screw cap 1 is screwed onto the bottle neck 11.

When the screw cap 1 is screwed onto the neck 11 of the bottle 13, the top face 33 and in particular the peripheral edge 39 thereof at the neck 11 of the bottle 13, displaces the sealing lip 19 radially outwards. The stepped zone of sealing lip 19 is thereby substantially filled by the membrane 37. The same applies to the space between the two spacers 31 and 35 and in part to the annular groove 28 between the sealing lip 19 and the exterior spacer 31 (cf. Figure 3). The periphery of the membrane 37 is bent downwards about the edge 39 of the bottle neck 11. In this condition and at normal pressure conditions within the bottle 13, the screw cap 1 will guarantee a perfect and tight closure of the bottle 13 by pressing the membrane 36 onto the bottle neck 11 with a large contact surface.

When the pressure inside the bottle 13 increases above a predetermined level as a result of fermentation or an excessive heating of the bottle contents, this causes a dome-shaped bulging of the cap bottom 3 (Figure 4). The bulging of cap bottom 3 is permitted by the annular reduction in the thickness of the cap bottom 3 in the region of the peak S_1 and the groove 28 between the sealing lip 19 and the spacer 31.

The bulging of the cap also permits the sealing lip 19 itself to move slightly axially upwards and a radial inward displacement of a point Q in the region of the root zone 29 ensues. This causes the sealing lip 19 to tilt about point P on step 23. As a result of this movement of the sealing lip 19, its tip 24 lying at h_1 lifts radially outwards and permits the closing membrane 37, which is clamped between the sealing lip 19 and the bottle neck 11, to be displaced in a direction which is also outwards and upwards. This translational movement decreases the pressure of the sealing lip 19 upon the edge 39 of the bottle neck 11 and simultaneously lifts the two spacers 31 and 35. The pressure of the closure membrane 37 upon the central zone of the top face 33 of the bottle neck 11 is thus reduced and enables gas to blow off to reduce the overpressure within the bottle. The blow-off is also assisted by movement of the closure membrane 37 into the space between the sealing lip 19 and the spacer 31 (cf. Figure 5).

As soon as the pressure within the bottle 13 decreases, the bulging of the cap bottom 3 reduces and the bottle 13 is once more tightly sealed by means of the screw cap 1.